
Satellite Weather Information Service

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Agenda

- Purpose and Effort
- Team Members
- Aircraft Configuration
- Present Air Coverage
- Geographical Coverage
- Data Routing and Timing
- Weather Graphics
- Future Possibilities

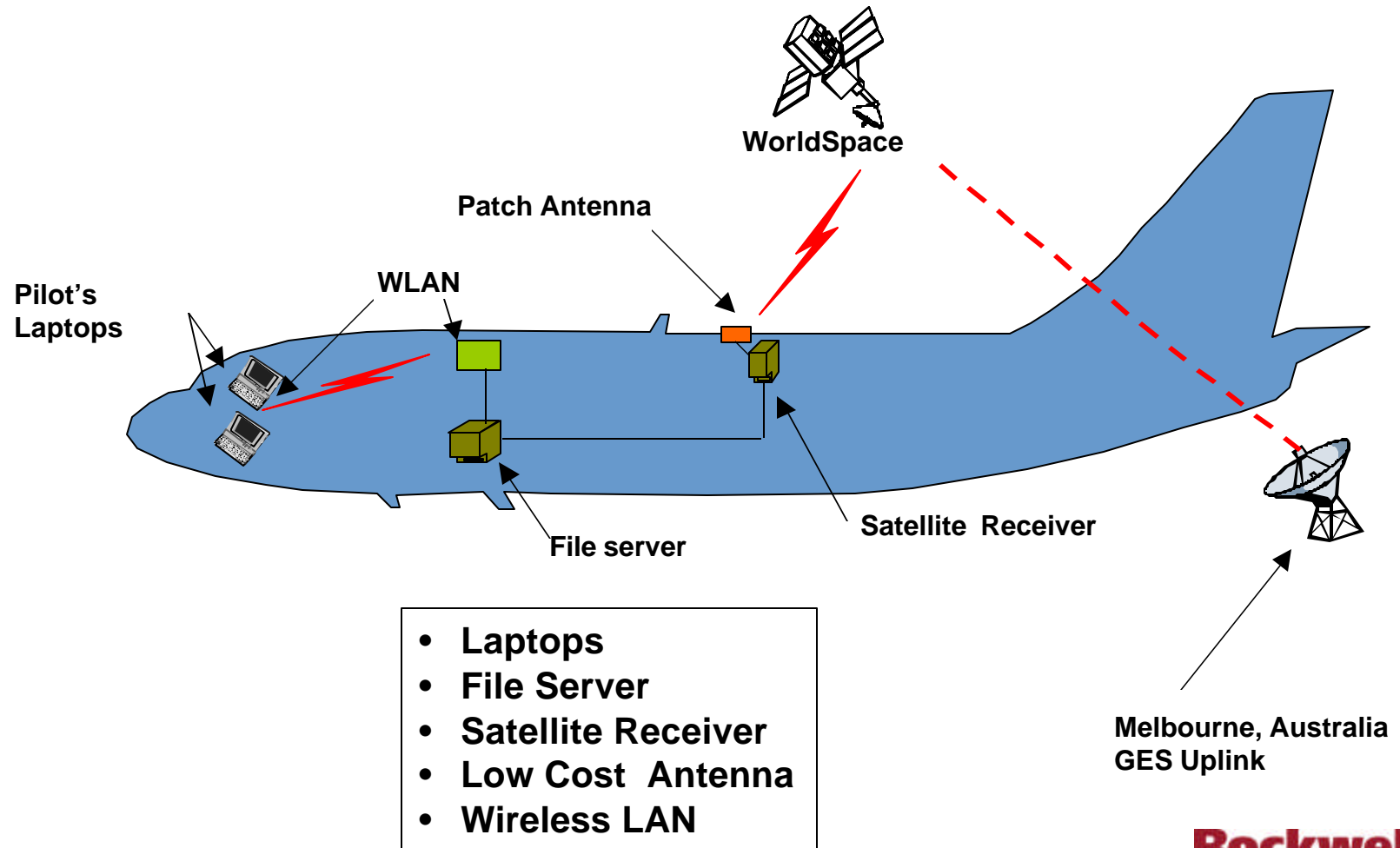
Purpose and Effort

- Purpose :
 - Provide updated graphical weather to air transport aircraft while enroute where there is no ground support infrastructure.
 - Improve flight safety, reduce fuel burn, improve time enroute.
- Efforts:
 - Trials on Revenue service aircraft
 - Verify commercial benefits and technology feasibility

Team Members

- Rockwell Collins
 - File Server, Displays, Receivers, Antennas, Wireless LAN, Integration, STC, Data Reduction and Analysis
- WorldSpace Corporation
 - Satellite Channel, Receiver Card, Ground Station Feed
- Jeppesen
 - Weather Products & Laptop Software
- American Airlines
 - STC Installation Support, Flight Test and Evaluation
- NASA Glenn Research Center
 - Support

System Configuration



System Elements

- Systems installed on two American Airlines B777-200 in revenue service. STC approved by FAA. System includes:
 - Patch antenna,
 - Satellite receiver,
 - File Server Unit (FSU),
 - Avionics Secure Interface Unit,
 - Wireless LAN network and
 - Pilot laptop computer(s)
 - Approved Software
- Trials started in May 2001, completed in Feb 2002.

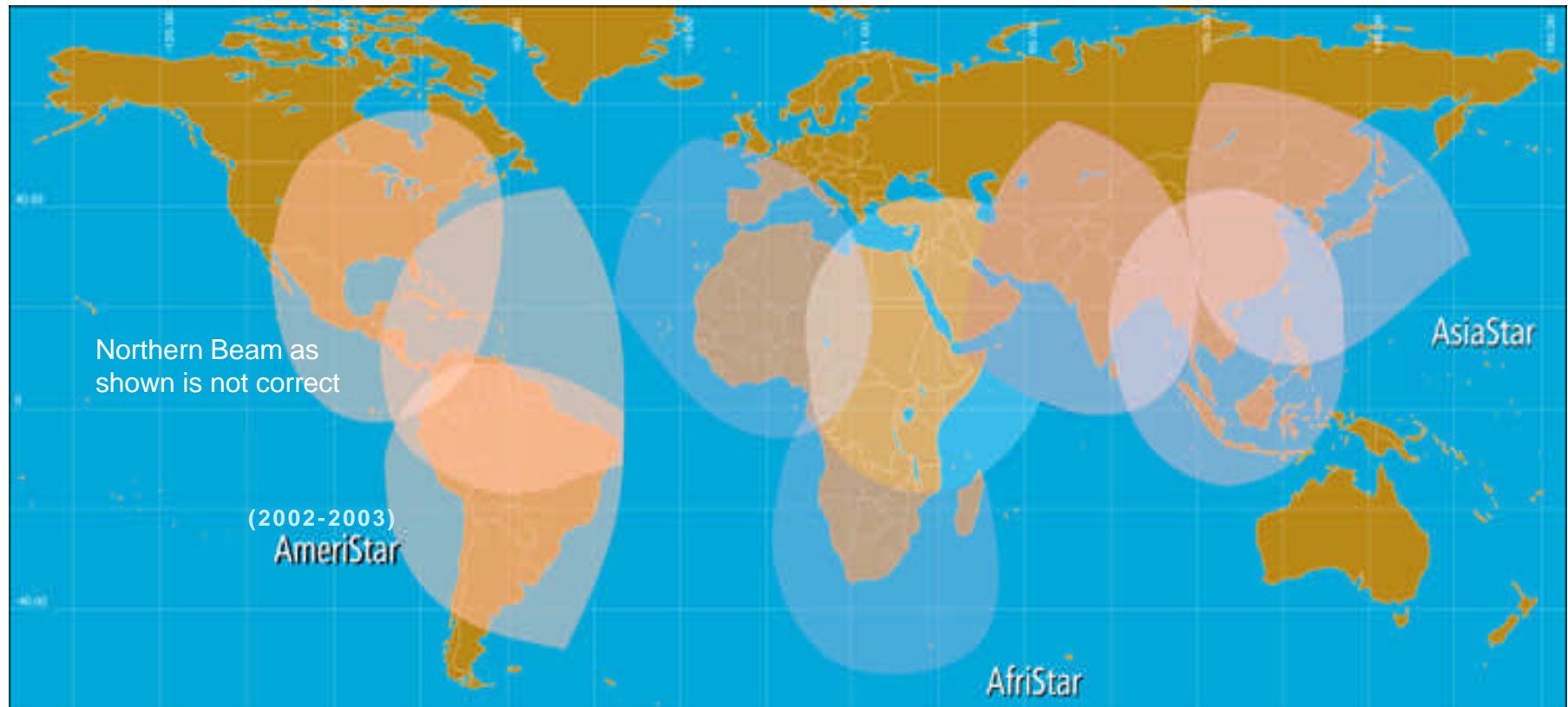
Antenna and Receiver Installation



Geographical Coverage

- WorldSpace satellites:
 - Africa serves entire Africa and some Europe
 - Central America (2002-2003), to serve S. American and Caribbean
 - Asia, serves all of Pacific rim from Korea through Malaysia China and Eastern Russia, India, etc.
- Trials used Asiastar's North East beam to support N. Pacific routes

WorldSpace Coverage Areas

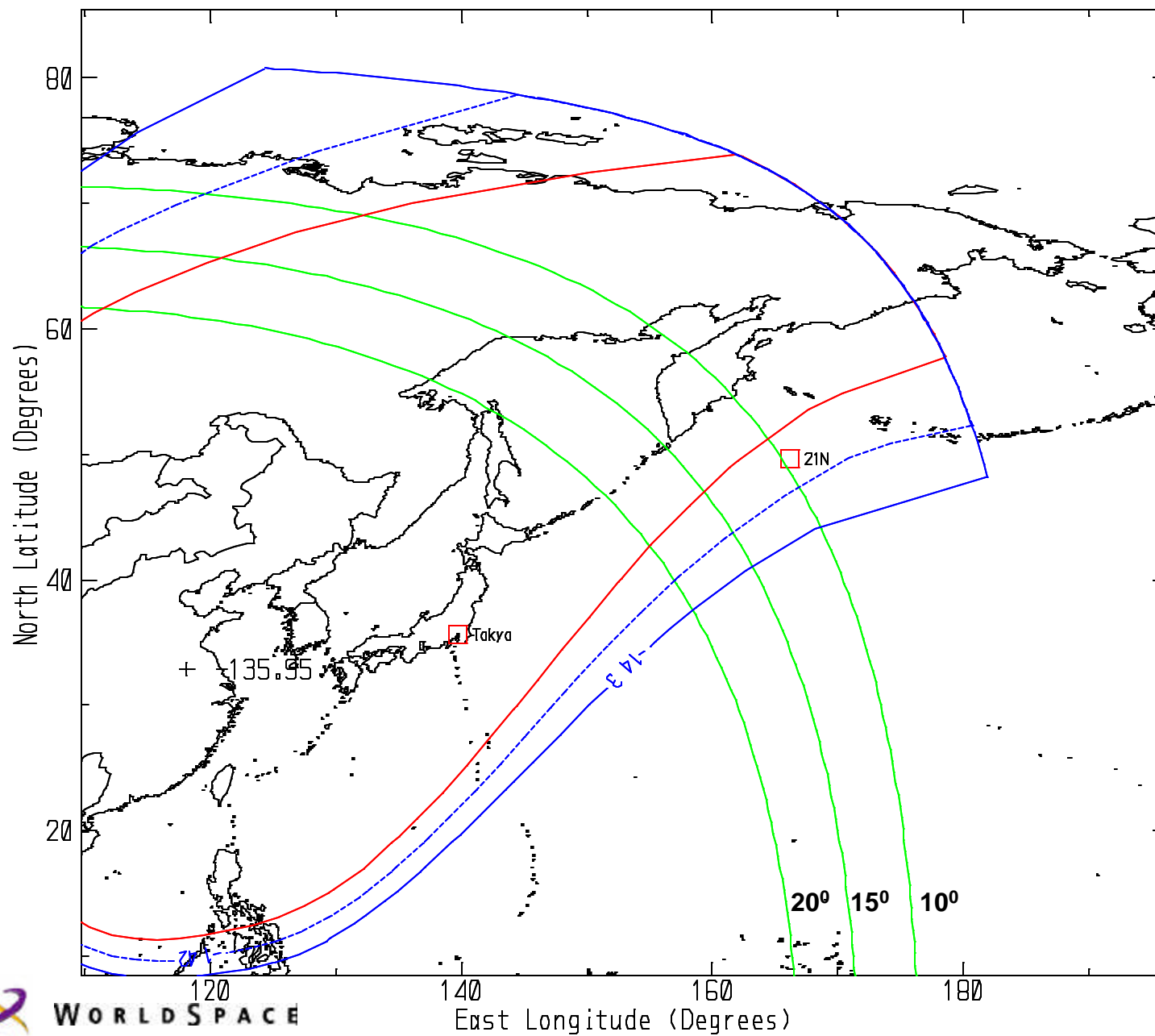


(NOTE: AmeriStar footprint shown pending frequency coordination outcome)

Route Coverage

- B777-200 aircraft operate as needed for all long haul routes for American Airlines, not just transpacific routes.
 - City pairs where system was used include:
 - Chicago, Dallas, San Jose CA to and from:
 - Narita, Osaka and Taipei.
- System provides coverage using NE Asiastar Beam (see map)
 - Coverage initiated SW of Aleutian Islands (WP 21N)
- Analysis data obtained from Questionnaires and Flight data

SWIS: Data Reception Near Kamchatka Peninsula



Initial reception at
waypoint 21N.

Center of Beam
over China at +
mark as indicated

Data Routing

- Jeppesen generates weather graphics at scheduled intervals at Los Gatos, CA.
- Graphics are encoded and sent to WorldSpace Ground Earth Station in Melbourne, Australia via Internet FTP.
- Melbourne GES uplinks each file to satellite 3 times at short intervals.
- Satellite transmits data at 64 Kbits/second.

Data routing (cont'd)

- Satellite receiver recovers files, checks data validity and transfers valid data to File Server Unit (FSU) for storage.
- FSU manages data files and makes files available to pilot via WLAN on aircraft.
- FSU maintains aircraft position and time. Provides information to laptop to allow aircraft to be plotted on graphics.
- Time delay from Jeppesen to Aircraft is less than 60 seconds.
 - Satellite typical transmission time - 2.5 to 5 seconds

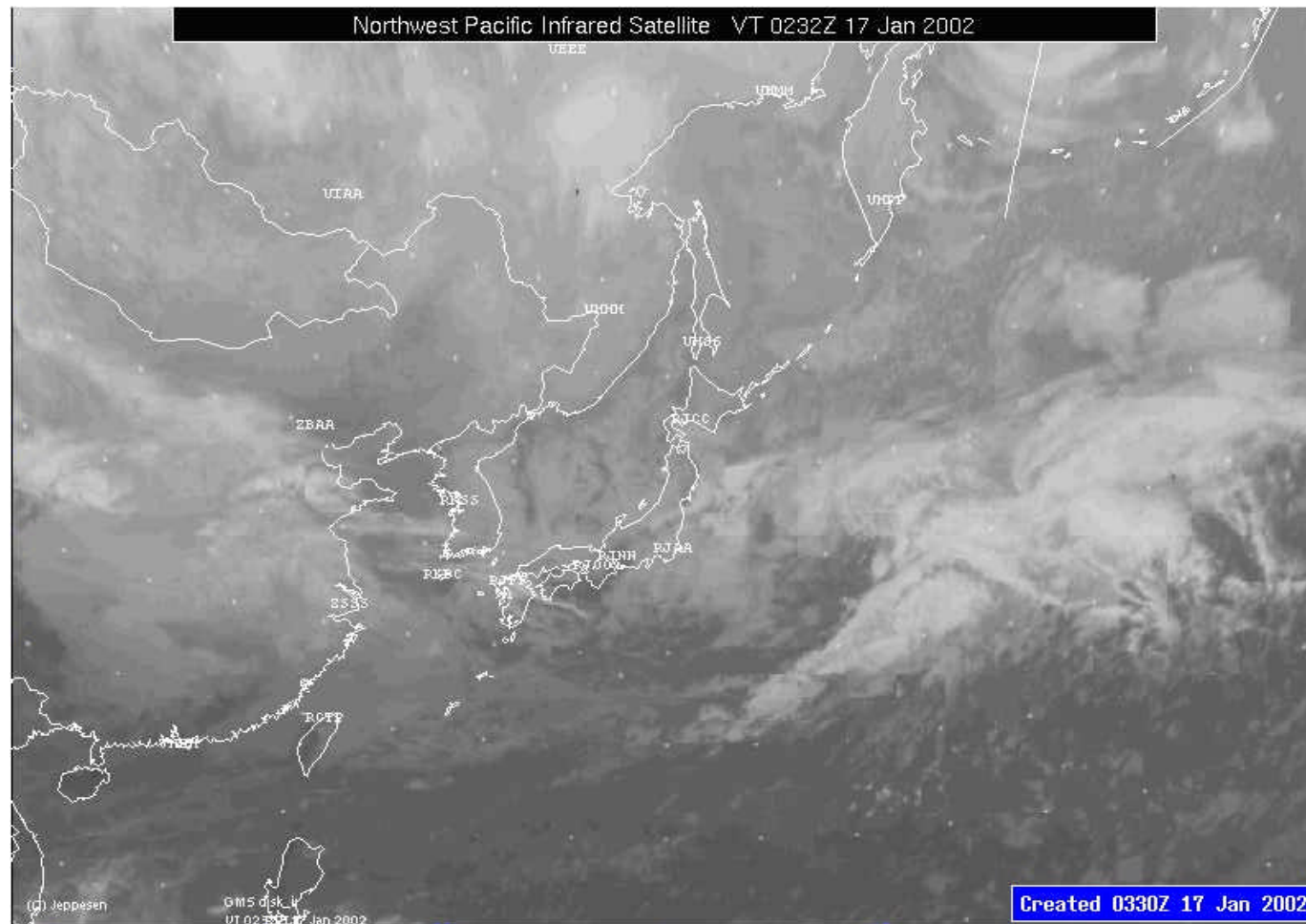
Weather Graphics

- Winds and Temperatures aloft
 - **Flight Levels 050 through 450**
- Surface Weather (Ceiling, Winds and Visibility)
- Hi-level Significant Weather
- Visible and Infra Red satellite imagery
- Surface analysis

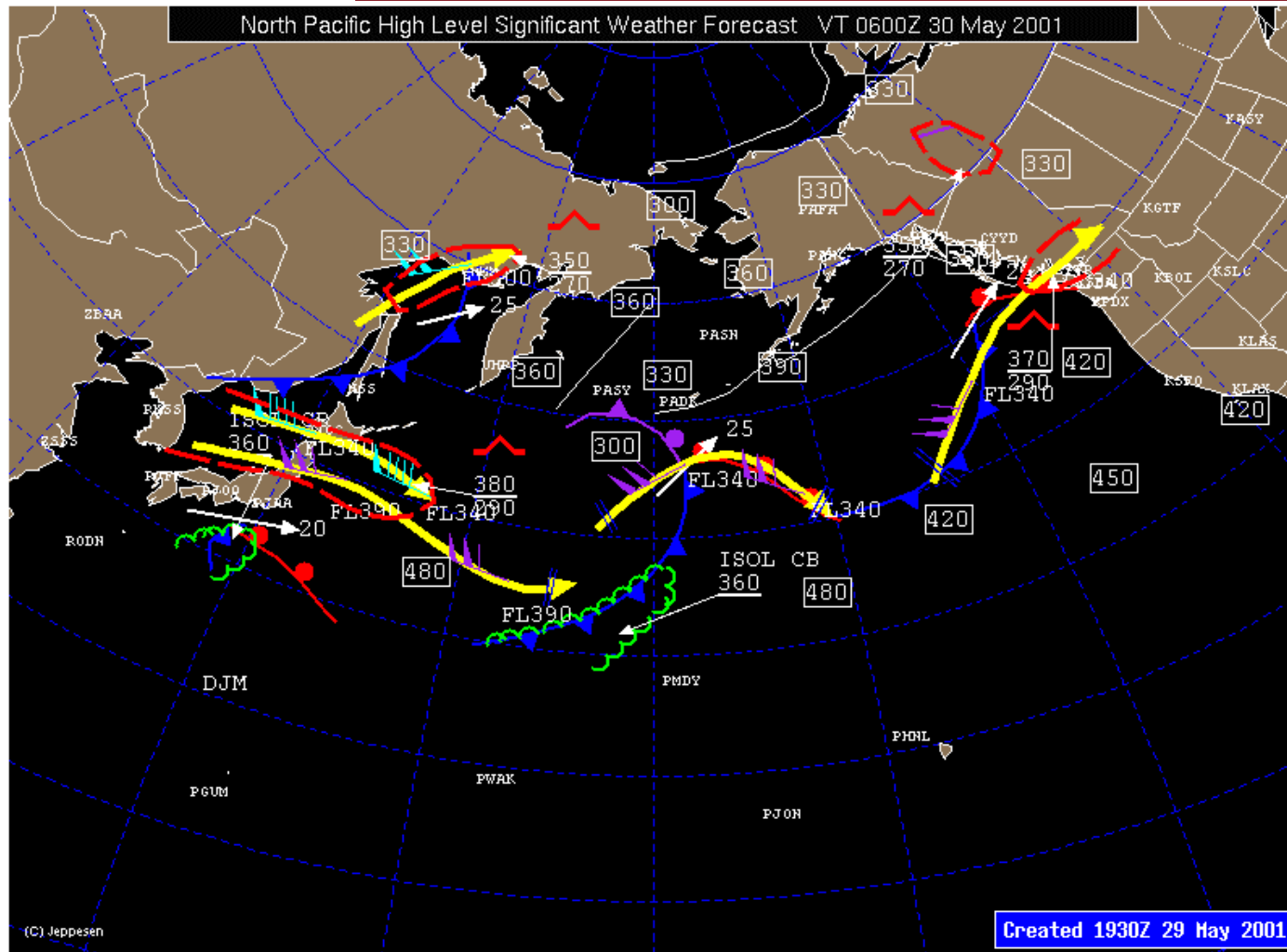
Weather Graphics

- Update rate varies from once per 30 minutes to once per 6 hours
 - **Specific to type of graphic**
- All weather graphics have track file and aircraft position overlays, zoom capability.
- Detailed geographic features and airport diagrams can be inserted by pilots as needed.
- File server provides “time lapse” weather movement graphics as called for by pilots

Infra Red Imagery

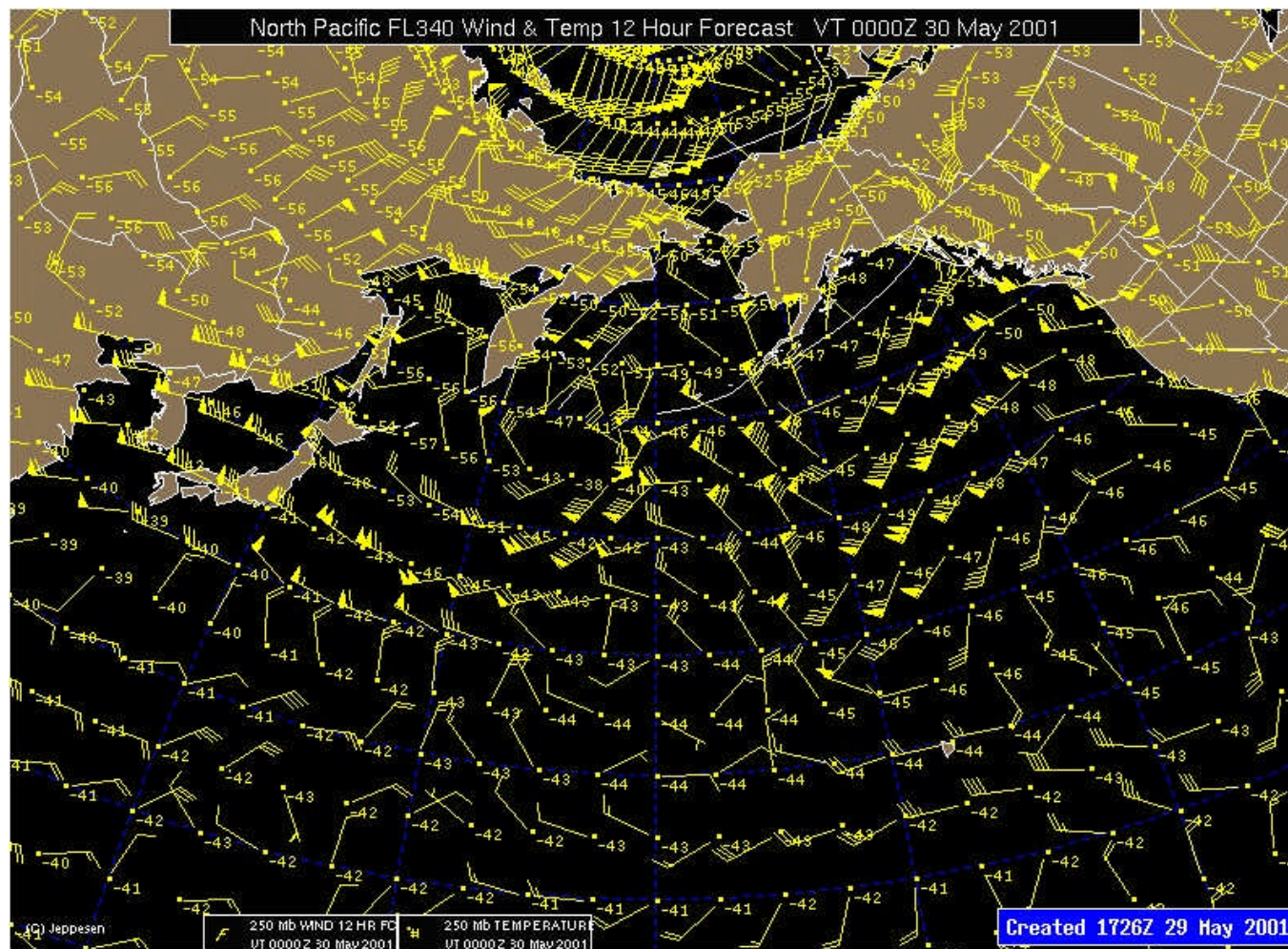


N. Pacific High Level Significant WX

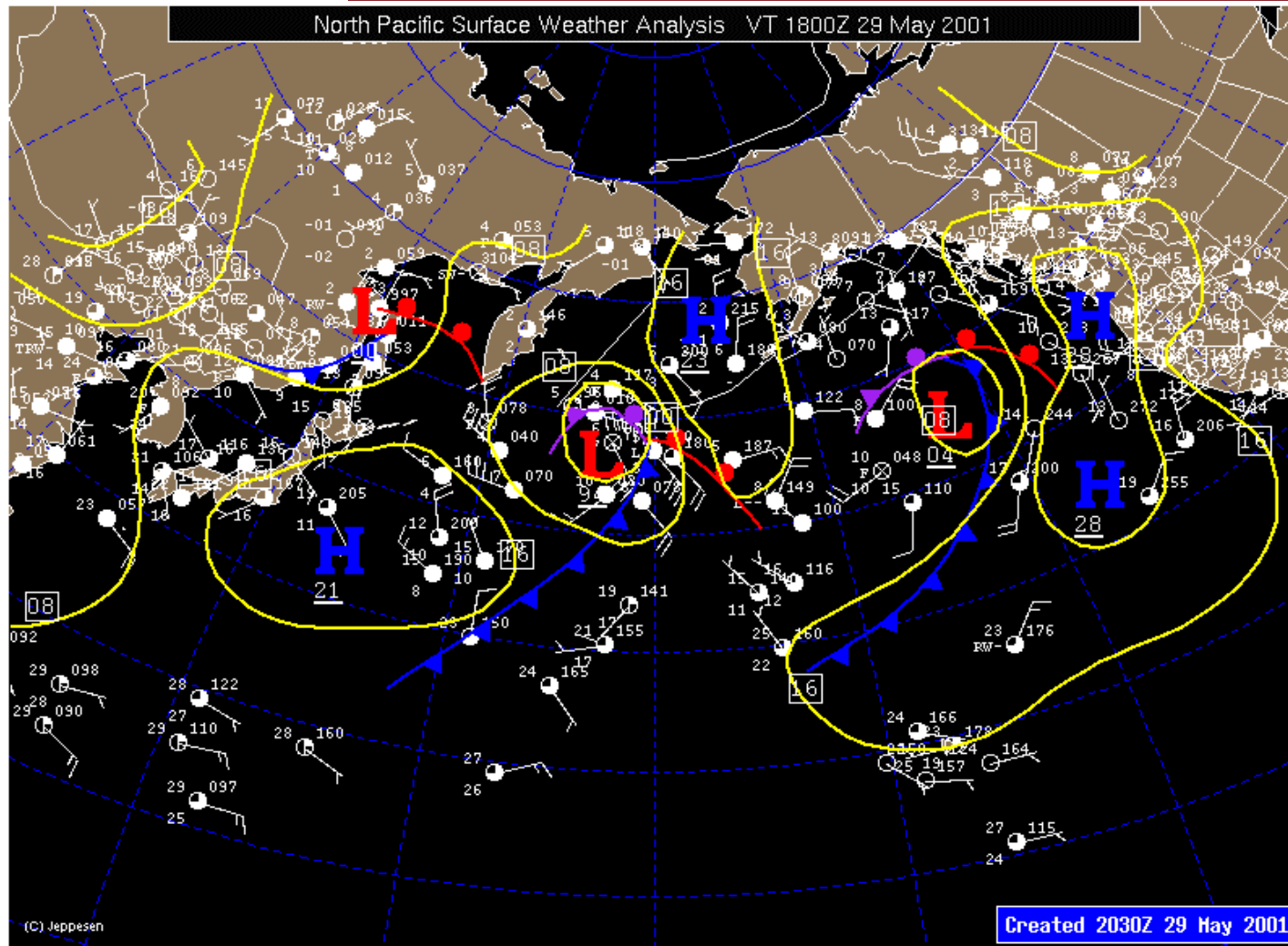


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N. Pacific Winds, FL 340



Surface Analysis



Results

- Signal coverage initiated 1600 miles East of Narita.
 - Elevation angle, 10 degrees above aircraft horizon
 - Signal reception, very reliable and dependable
- Pilots reaction to the system was very favorable. System provided up-to date information which allowed pilots to make in-flight route changes to avoid poor weather.
- From pilots request, we added CONUS information to the weather downlink to aid pilots returning to the US.
- Updates averaged 12 new graphics each hour.

Future Possibilities

- Provide Additional Geographical Coverage
 - Use other satellite systems, both CONUS and elsewhere
 - Maintain low cost system implementation options
 - Patch antenna,
 - Receive Only capability
 - Other graphical display devices
 - Additional or different graphical weather information
 - Distribute non-weather information